Remarks
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Introduction – NOAA provides Environmental Intelligence

Thank you. I'm delighted to be here today with all of you today, and to see so many of our key partners here in the room around me, and visit with you over breakfast, partners like as Assurance Technology Corporation, Ball Aerospace and Technology, Lockheed Martin, Northrop Grumman, Raytheon, Harris, Exelis, many many more.

We're working with many players in this sector on a wide array of both space segment and also ground segment projects. For example, Raytheon is deploying our AWIPS II system – that's the computer workstation our forecasters use to meld, combine and mash up all the different strands of data that they have before them as they make your weather forecast. And they're also developing a training module that will really be a great contribution to our Weather Ready Nation initiative.

With Boeing, we are testing the use of an autonomous underwater vehicles that might better improve how we do fish stock assessments to three dimensional planets. The ocean's pretty important there.

And of course in 2015--in the early months of 2015--we are slated to launch two satellites – the DSCOVR space sentinel mission and Jason-3 radar altimetry mission – on SpaceX Falcon 9 vehicles.

At NOAA, we see ourselves as America's Environmental Intelligence agency. That means we provide the timely, reliable science-based information that citizens, communities and businesses need to stay safe and operate efficiently, as Marian was alluding to. The cornerstone of this work is perhaps NOAA's most distinctive niche among all federal agencies, and that is the art and the capability of **practical prediction**.

This all starts with keeping the pulse of the planet - and that's really why NOAA has become and long been the nation's operational earth observation agency. But Environmental Intelligence of course is more than just science data. Turning science grade measurements and data into Enviro Intel involves melding the foundational measurements that characterize this earth that we live on with scientific modeling and analysis, to produce useful information.

Timely, reliable, actionable and action-oriented information. This is the kind of information, this is the Environmental Intelligence, that not only provides us with powerful situational awareness, but also with insight and perspective about the conditions of the environment around us. And even more importantly, this kind of Environmental Intelligence provides us with **foresight,** the ability to look ahead, anticipate future conditions and assess alternative courses of action we might take, depending on which ones materialize.

Marian touched on a number of great examples, from day to day operational military activities at CONUS, airline system operations, crop outlooks, water managers, you name them. You might call this, and some do, a 'big data' problem, but let me emphasize it is not a data mining problem, because this little planet we live on is so incredibly dynamic. So the Environmental Intelligence enterprise depends critically on robust, accurate real time observations, and that of course is exactly where space systems play a central and indispensable role. It's only via space-based Earth observations that can we get an essentially instantaneous snapshot of Earth's dynamic systems. You see here a blue marble image assembled out of a set of swaths from the NOAA/NASA SUOMI NPP satellite for example.

I might pause and emphasize something here I think we all forget, but that's a pretty amazing cosmic-scale point. Look around this room, look at your kids and grandkids, think of your parents at the oldest. We are the first group of human beings ever in the history of the planet or of humankind, ever, to have this kind of capability. This is really new stuff--to be able to snapshot the planet in quantitative ways and combine that sense of the planet's current state with computational capability to have this kind of foresight.

There's a quote from the House of Commons in the late 1880s from a fine gentleman scientist who stood up and said to the assembled crowd that he thought science was advancing at such a pace that before too long, it might be possible to know the condition of the weather in this city the next day. *[Laughter.]* And he was laughed out of the room! And we now take for granted five

and ten day forecasts, and seasonal and longer outlooks. This is an extraordinary period that we are living in. And this ability to snapshot the earth from space plays a critical role.

But the space-based data are not sufficient in and of themselves. Practical prediction and actionable environmental intelligence also require data from *in situ* platforms, for calibration and to really get at the third dimension that often times the space-based measurements don't provide. And at NOAA these include planes, ships, buoys, radars, weather balloons, wave gliders to name just a few. Again, many of your companies, although there are space and defense sector, have business in these arenas as well. These systems are some of them owned and operated by NOAA as a government agency, but in many other cases, they are owned and operated by private companies and academic partners.

I have three priorities for NOAA as administrator: in short form, they are to increase the information and services we provide that help communities become more resilient, to evolve the National Weather Service to ensure it remains world class service second to none, and to invest in observational infrastructure.

And it's that third priority that I want to talk about today--Investing in our infrastructure. More specifically, I want to talk this morning about some of the central questions and policy points that drive our observation planning and investment.

Let me emphasize at the outset, before going down that road, how clearly and visibly we appreciate the critical roles that many of your companies play in developing, fielding and operating this infrastructure. It is only through the very robust relationships, and the capacity and expertise of your companies that we have been able to field and sustain these vital observing capabilities for so long. And we are tremendously proud of those relationships, and of the really strong partnerships that we have forged with so many of the companies here today - and not least of the really tremendous things in service of our country and the world in fact what we have accomplished together.

So I'm going to be candid with you today about where I see our observational portfolio going, what imperatives I believe we must respond to as a community and what principles are guiding our thinking as we move forward in the years ahead.

Those decisions and our planning will be guided principally by two principles that have been proven very robust and taken us to where we are in the decades behind.

The first of these is that weather forecasting is an inherently global enterprise, and the global weather enterprise works because the foundational weather and climate data--the foundational measurements--that enable practical prediction are treated as global public goods, necessary for public safety and the safe operation of communities and businesses.

And the second is that these public data constitute a tremendously powerful open innovation platform, which in this country is leveraged by a private sector weather and climate industry valued by various estimates at multi-billions per annum.

Two added points here: Fostering this vibrant innovation platform for the commercial sector is a 100-percent explicit aim of NOAA and the United States government. And secondly, NOAA these days with what we call this private public model of weather enterprise--we literally cannot fulfill our public safety mission without today's private weather enterprise in the United States, and I'll get back to that in a little bit.

Commitment to the Global Weather Enterprise

Our commitment to this global enterprise – both the public and the private components of it--or more accurately actually the global weather, water and climate enterprise – is really very firm. This is truly a planet-wide collaboration. And that collaboration is based on the first of the two principles I just said. Collectively, all the nations and governments of the world treating the foundational environmental measurements as global public goods.

So let's talk for a moment in very simple terms about how this enterprise works and unpack it just a bit more.

NOAA deploys and operates observing systems like the ones I've mentioned – satellites, buoys, ships, wave gliders, and so on.

These data feed into numerical models that embody the earth system knowledge and understanding that mankind has generated over decades of research and development. These models propagate the current conditions in the initial stage into a projection of the future - a model output. And finally, the last step in turning all of that into a forecast is talented forecasters meld this initial model guidance with more localized information to produce your weather forecast, or a drought outlook or any number of information products. That cycle I just described in simple terms happens in national met services around the globe and at National Weather Service in NOAA in a 24x7x365, every six hour cycle, unless Mother Nature throws something at us that makes us speed the cycle up even further.

And at virtually every single step in that chain we rely on partners. You are our partners in the design, the development, the launch, and the flight operations of the satellites that provide the greatest volume of the data that goes into these numerical models. Your companies help us build and maintain the systems we use to get our model guidance to forecasters around the country and then to get our forecast products out to users. So throughout the entire production and value chain, it's truly a public-private partnership.

That thumbnail leaves out, or doesn't do justice at any rate, to one of the more important features of this enterprise, and that's the one intended by the phrase "planet-wide collaboration." Let me delve into that a little further.

All of the data NOAA collects, all of it, is shared in near-real-time with meteorological services around the globe, and we get all of their data in return.

This is goes on through initiatives like the World Meteorological Organization's World Weather Watch with its three World Met Centers – in Melbourne, Moscow and Washington – and fifteen WMO telecommunication hubs in the U.K., France, Germany, Japan, Brazil, Argentina, India, South Africa, Algeria, Bulgaria, China, the Czech Republic, Kenya, Saudi Arabia and Senegal. One hundred ninety-one countries and territories share environmental data with each other through these mechanisms.

The global weather enterprise is built on the principle that earth systems data – the basic measurements of our atmosphere, ocean, land and cryosphere – are public goods that are essential for public safety, that no single nation can sample the globe adequately for any nation

to have a viable weather forecast. And so only the collaboration of countries around this common public good can make this happen. It exists, today's weather enterprise, exists and is sustained by the free and open sharing of both these foundational observations and the underlying scientific research.

So here are some of the assets that we share to get this all done.

With every passing season it becomes ever more obvious to us at NOAA that the data we and our partners generate and use to produce these forecast products and services – a 13 minute tornado warning, a spring flood outlook the real vital role these play assuring economic vitality and efficiency and public safety.

And that's what strengthens our commitment to ensuring that our data remain public goods, and to working with our partners to cement their commitment around the globe. I've just returned on Saturday for example from the Group on Earth Observations in Geneva, representing the United States in this voluntary body of 95 countries that collaborate together to ensure these foundational data are free, open, accessible, interoperable, and available to serve societal needs, whether that final delivery is through public or private channels.

So NOAA has and will continue to share the vast majority of our data publicly, and at no cost, to users here in the US and around the world.

I do want to emphasize again how not a one-way street this is. We in the United States, through the quality and ability to do the kind of forecasting you rely on us to do, we benefit in equal measure from the sharing of data we get from those 190 other countries around the world. But this interconnectedness of the global weather enterprise I've been talking about doesn't start and end just with sharing the raw data. We also share our model output.

The state of the art in weather forecasting today relies on this use of Multiple Model Ensembles, clusters of models that each have their strengths and weaknesses. So this is an approach that lets the strengths of each model reinforce, and the error tendencies of each model cancel out, getting a more robust result at longer and longer time scales. And this reliance on Multiple Model Ensembles makes the value of these international partnerships and sharing arrangements higher than even before.

This Multiple Model Ensemble process is the cornerstone of our ability to extend forecasts out to the longer timescales, as our users in every sector of society increasingly demand.

So this mutual interdependence in the weather-water-climate enterprise is if anything only growing and taking on some new dimensions. And happily, we can really bank on this for key national needs because of the deep trust and strong culture of data sharing that we have forged over decades of mutual reliance.

Let me make this a little more concrete. Marian mentioned Hurricane Sandy, Superstorm Sandy, and I'm sure you all recall reading in the press that the European Center's global model picked up Sandy's "left hook" into New Jersey a few days before ours did, at seven days out. But look, who beat who in a particular forecast cycle on one storm is, it's media hype, it's the sports rubric of media coverage, it's not really the important point.

Any model will get a certain storm or a certain phenomena better in some instances than another, and vice versa. The important point - what we really need to focus on - is how accurate was the end forecast product that came out, and how did all these lash-ups I've been talking to contribute to this forecast.

Because the forecast the National Weather Service delivered to the United States public came out of our meteorologists' analysis of ***all*** the model output-- of the European model, of the NOAA global forecast model, of the U.K. Met Office, the Canadian model--you name it. To see these strengths and cancel out the errors they all have at these kind of timescales.

And this ability to run those ensembles, to have that robustness in the final outcome, to give Craig Fugate the 80-percent confidence four days out that he really does need to start shutting down Manhattan, that is only possible because of this robust and open exchange of the foundational measurements and model output.

So there's Sandy, and we're watching it evolve and run up the coast. And you'll see that left hook, and you'll see storm itself, you'll see the error cone, the forecast cone that the National Weather Service put out, which was built on that reliance on all of those models.

Let me think back to the other side of the equation. Suppose for some reason, everyone monopolized their data and we didn't have this sharing arrangement. Suppose we had deprived the Europeans of our data, our forecast – not our model, perhaps, but our forecast – would have suffered in the end, because we would have broken the exchange of the model data as well. So this interdependency is a real proven capability.

Providing a foundation for the private weather enterprise

In addition to serving as the foundation for global public safety, as I have said before, there is another real tangible upside to treating weather, water and climate data as global public goods, and that is that these data constitute such a powerful and open innovation platform, and that platform fuels both highly profitable commercial enterprises and a very vibrant research community.

Specifically, the ability of private weather enterprise to flourish creates real economic benefit for this country – benefit from the volume of products and services created, the high quality private sector jobs that go into making those value added products and services, and the upside improvements to end users from United Airlines to FedEx to you name it – smoothing inventory management, airline routing, countless other commercial interests, and last but not at all least, rapid-fire innovation in the mobile applications arena, to name just a few. The sum of all of these activities delivers tremendous tangible economic benefits to the country - the *total prosperity effect* of this arrangement is truly impressive.

NOAA believes that the right public sector role, in addition to ensuring public safety, is to set this platform, to establish this platform, for private innovation – and that the United States' model of treating global weather data as a public good does that, and is the best and right way to do that.

The vibrancy of the U.S. private weather enterprise makes this point vividly. Unlike the National Weather Service of 50 years ago, NOAA today literally could not fulfill its mission of providing timely, accurate and reliable information to the American people – without private weather companies.

The on-air weather broadcasts, the tailored [business-to-business] services, mobile applications, all those products and services these private companies develop and support are

vital. In fact, these companies now comprise the lion's share of our national dissemination architecture.

It's not always been an easy, happy family relationship. NOAA and the private sector have been at odds with each other at times in the past. Sorting out and understanding where one role stops and the other role starts, and dealing with that and sustaining that dynamic relationship through multiple waves of technological and societal change--this takes a lot of time and patience and enormous amounts of conversations, as any sustained partnership takes. And those conversations continue today, and will continue for quite some time I'm sure.

But in the last couple of decades we have truly stitched together a remarkably strong partnership, and one that, frankly, is the envy of the world.

We retain, in the public sector, the responsibility for providing life-saving and property-saving information and services. We release the data to the private sector so all comers can capitalize on that and develop a product, a service, a business that they see an opportunity for, and build their value on top of that.

The arrangement has produced a private sector that funds and fuels innovation at a pace that government nowadays couldn't imagine keeping up with, and has allowed NOAA on the private side to focus efficiently and cost effectively on our primary role.

So, our commitment to this model rests on three things. It makes the public sector more focused and efficient at what it centrally needs to do. It sustains this public-private balance in the weather enterprise that makes the global forecasting capability a possibility. And it has delivered such vibrant public sector growth and economic return to the country.

The challenge for all of us, and in another way, of tremendous and rapid change, is to work together to find business models that can sustain and even further commercial sector participation in this global enterprise, and yet sustain these three key objectives.

A couple of other considerations, are worth mentioning here today.

First, I would hope you all could understand--because you all build and operate systems of great importance, too--the rigorous process that the National Weather Service uses to evaluate new sources of data, and why we do that. As we expand our observational capabilities, whether through government produced systems, international partnerships, or commercial solutions – it's imperative we maintain the strong set of standards for accepting and ingesting new sets of data into our enterprise, because if we don't, we quickly degrade the forecasts and reliability people count on.

We've an explicit set of sixteen criteria that we evaluate every from the next anemometer to the next satellite instrument against. They consider data quality, format, timeliness, cost benefit, processing requirements, cyber security and others.

And we don't do that to be obstructionist. This enterprise is like, I always liken it to running endless 4-by-100 relays and the baton pass has be dead on, or the next forecast cycle starts to degrade and the millions of people that are presuming nowadays that they can count on the forecast, and bank a business decision on it, you can count on a forecast and bank community safety on it, that's a tremendous bond of trust that's been built through the quality of this enterprise.

We need to do Olympic quality baton passes here, and so we need to be sure before we pull a known, proven data stream out and put a new one that we understand the attributes of that data stream, lest we fall victim to the standard "garbage in, garbage out." You might be surprised how quickly even an undetected bias that creeps into a sensor can really wreak havoc with the forecast.

So we're focused on this set of standards because we're focused on avoiding the downstream user impacts that risk public safety and topple economic efficiency.

I sure wish this process was easier and simpler. I'm sure many of do, too. We are working on ways that we can improve, streamline the timeline, be more effective at exercising this set of standards. We're usually constrained by the simple reality that this is the unsexy work that no one likes to devote much research to. Who likes to have a lot of money in calibration and validation? You want it out on the pointy end. So as we explore more ways together to expand

or modify our commercial partnerships, your attention to this limitation is something that might help us as well.

The second point I wanted to add here is, of course, the cost efficiency and cost effectiveness approach. We are spending other people's money--we're spending your money, my money, the taxpayers' money, and it's imperative that we make sure that we do that in a cost effective way that looks not just from the hardware box that potentially is a new capability but all the way through the production chain to make sure that we're not needlessly introducing incremental non-recurring expenses throughout that chain.

Despite all I've said, you might be thinking--I don't know quite what you're thinking--but you might be wondering "Are these guys open? They sort of like private sector engagement a lot, but are they open to exploring, and open to change?" We have to be open to change; the world is changing all around us at very rapid speeds. We see that every single day.

Increasing Engagement w/Commercial Sector

We're very open to working with you to find new business models that can achieve these goals of improved mission effectiveness, clear public-private rules and distinctions, and more rapid, more vibrant commercial growth and engagement.

And I believe, with the support of this administration's Space Policy, that we can do that together. We, of course, will take care of those discussions, to be sure that we don't go with models that compromise our ability to deliver our mission,
or undermine the capability of the global enterprise that we ourselves in the United States depend on. The stakes of delivering environmental intelligence to communities and businesses are just too high for us to jeopardize the enterprise on models that cavalierly abandon these strong and proven principles.

By the way, we do today purchase some significant quantities of commercial data – signals instead of hardware. For example, we buy lightning data from both Earth Networks and Vaisala. It's a private good, they sell it to us, and we forego any rights to redistribute it to other partners. So why is that okay with us, given all the things I've said? The simple answer is that these are local to regional scale data sets. The lack of localized lightning data from Oklahoma does not

degrade the global enterprise. It does not affect the capability of the European or the Japanese or any of other models that we share and rely on--the models that our meteorologists here in the United States use to make sure you're getting the most accurate possible forecasts for the United States and for U.S. interests around the globe.

So that's a routine practice. We do a lot of that and we're open to doing more of it. But in contrast, if we were to deny our European partners access to the data that we currently receive from a global mission – for example, the GPS radio occultation mission, something like COSMIC – that clearly would have an effect on the global mission and on United States end forecast products. It would erode every model and therefore erode the total capability of the ensemble methods. They are the underpinning of the reliability and actionability that we all count on.

So that's where we, one of the places we would make a distinction, and it's not a trivial distinction.

I launched earlier this year a process at NOAA to explore and look for and define business models that might satisfy these conditions we've been talking about, and expand the ways in which we engage with the private sector to fulfill our mission.

We plan to release that policy before the end of this year. It will help us at NOAA increase our support for commercial solutions, while maintaining these key capabilities that I've been speaking about. I want to highlight, we didn't do this on our own. This was not an entirely internal NOAA exercise by any means. It would not have been possible without the focused work of other partners in the Department of Commerce, one of our federal advisory committees, and the ITA bureau called Industry Trade Advisory Committee for Aerospace Equipment, I'm sure many of you know it--ITAC-1--and we engaged ITAC-1 to assemble a group that would bring important commercial voices to the table, challenge our thinking, and give us some new approaches and ideas to consider and stretch our brains together a little bit.

So I want to thank the ITAC-1 chairman, Greg Dole, and our Space Subcommittee chairman, Liam Weston, for their hard work over the last several months.

Conclusion

I've considered the companies represented here in this room today critically important partners of mine for decades. As Marian alluded to, some of you took me for quite a ride some 30 years ago, and I was not one of those people who sat on the pointy end of the rocket watching over private enterprises that skimped on margins or charged the lowest bid. I had great confidence in the hardware I was riding and the teams that I had worked with to assemble the staff and assemble the payloads. We were going on that ride together, we were embarked on a mission together, and I had great confidence in that then. And I have no doubt that none of you are taking me for a ride now and we're still embarked on a great mission together. The trust remains very strong, and the partnerships remain critically important to NOAA and personally valuable to me.

Sitting in the NOAA administrator's seat, the demands for our products and services are growing at a remarkable rate, and diversifying as well. And so it's really imperative that our mission and our capabilities must grow and keep pace with those demands. In the coming decades, that means pretty simply we will need more quantity and a higher quality of the observations that allow us to understand this earth well enough to provide decision makers with the environmental intelligence that they need in the face of the rapid environmental change that we're experiencing around us, and the increasing vulnerability of people, communities, and businesses.

We will need buoys that can be affordably deployed and maintained; an exponentially expanded observing capacity in the Arctic as the scale of commerce there grows; satellites that are resilient against denser debris fields, less expensive to field, easier to sustain; next-generation radars. And the understanding and capability to operationalize the use of unmanned aerial and underwater vehicles in the environmental intelligence domain, as they're beginning to progress in other domains as well.

And all that tells me again that we will need more than ever before our partnerships with you and your continued support to make any of this happen because as each of you know, NOAA doesn't collect observations just for the sake of knowing more. We don't field systems just for the sake of having hardware. We do it because of the vital importance that actionable, timely

environmental intelligence has to the safety of our citizens, and the efficiency of our economy. And we do it because we live on the coolest planet in the solar system.

Thank you very much.